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SPECIFICATION FOR VARNISHED COTTON CLOTH AND TAPE FOR ELECTRICAL PURPOSES

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6 *July* 1966

IS : 3352 - 1965

Indian Standard
SPECIFICATION FOR VARNISHED COTTON CLOTH AND TAPE FOR ELECTRICAL PURPOSES

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Indian Standard

SPECIFICATION FOR VARNISHED COTTON CLOTH AND TAPE FOR ELECTRICAL PURPOSES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 June 1965, after the draft finalized by the Treated Fabrics Sectional Committee had been approved by the Chemical Division Council, Engineering Division Council and the Textile Division Council

0.2 There are two types of varnished cloth in general use for electrical insulation and although their properties do not differ very widely, their differences are sufficient to distinguish the type that is indicated for a particular application The advantages possessed by the black varnished cloth are greater moisture and water resisting properties, higher electric strength and better ageing properties.

0.3 This standard contains clauses **4.2.2.1** and **4.4** which call for agreement between the purchaser and supplier.

0.4 In the preparation of this standard, assistance has been derived from the following standards

B S. 419 · 1958 Varnished cotton cloth sheet and tape for electrical purposes British Standards Institution.

ASTM D 295: 1958 Standard methods of testing varnished cotton fabrics and varnished cotton fabric tapes used for electrical insulation. American Society for Testing and Materials.

Federal Specification HH-C 471 · 1945 Cloth and tape, cotton, varnished (for electrical insulation). Federal Supply Service, General Services Administration, USA

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final values, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off values should be the same as that of the specified values in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test for yellow and black varnished woven cotton cloth coated on both sides and of 0·13, 0·18 and 0·25 mm thickness, in the form of sheet and tape.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS: 2244-1965* and the following shall apply.

2.1 Bias — Material having threads at angles other than 90° to the edges.

2.2 Bias-Cut — Material cut so that both warp and weft threads make the same angles with the edges.

2.3 Panel Form Bias-Cut — Bias-cut material in short lengths not joined together.

2.4 Reel — Material in roll form when the width is less than 100 mm.

2.5 Roll — Material in roll form when the width is greater than 100 mm.

2.6 Seamless Bias-Cut — Bias-cut material woven and varnished in a continuous length.

2.7 Sewn Bias-Cut — Bias-cut material in short lengths sewn together before or after varnishing to form a continuous length.

2.8 Sheet — Woven cotton cloth of width exceeding 100 mm, varnished on both sides. Sheet may be either 'straight' or 'bias'.

2.9 Straight — Material having one set of threads parallel to the edges and the other set at right angles.

2.10 Straight-Cut — Material cut so that one set of threads (usually the warp) is parallel with the edges and the other set at right angles.

2.11 Tape — Material cut to a width not exceeding 100 mm. It may be either straight-cut or bias-cut and has no selvedges.

3. TYPES

3.1 Varnished cloth shall be of two types, namely, Type 1 and Type 2.

3.1.1 *Type* 1 — Yellow varnished cloth usually manufactured with a clear insulating varnish consisting of a drying oil in combination with a resin.

3.1.2 *Type* 2 — Black varnished cloth usually manufactured with a drying oil with which are incorporated bituminous substances and small amounts of resin.

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*Glossary of terms relating to treated fabrics. (Since revised).

4. REQUIREMENTS

4.1 General Requirements

4.1.1 *Description* — The surface of the varnished cloth shall be uniform, reasonably smooth and free from defects, such as bubbles, pinholes, creases and flaws, and shall show no tendency to adhere when in roll. The varnished cloth shall be flexible and the varnish shall not peel, flake or become brittle during storage at normal room temperature.

4.1.2 Material in tape form shall be supplied either cut parallel to the warp threads (straight-cut) or cut on the ' bias ' (bias-cut) with sewn seams or without seams (seamless). The bias-cut material shall be cut so that both the warp and weft threads make the same angle with the edges of the tape unless otherwise specified.

4.1.3 The material shall not be joined except in case of sewn bias-cut material unless agreed to between the purchaser and the supplier.

4.1.4 The material shall not be affected by cold or hot water, dilute acids or alkalies, salt solutions and impregnating varnishes.

4.2 Dimensional Requirements

4.2.1 *Tolerance on Thickness* — The tolerance on thickness of varnished cloth or tape, when measured in accordance with 8 of IS: 1954-1961* shall be as follows:

Nominal Thickne mm	*Tolerance* percent
0·13	+20
0·18	±10
0·25	±10

4.2.2 *Tolerance on Width* — The tolerance on the width shall be as follows.

4.2.2.1 *Cloth* — The tolerance on cloth of up to 90 cm in width shall be ±2·5 cm. The tolerance on cloths of widths over 90 cm shall be as agreed to between the purchaser and the supplier.

4.2.2.2 *Tape* — The tolerance on width of straight-cut or bias-cut tape of nominal width up to 100 mm shall be ±0·5 mm.

4.2.3 *Tolerance on Length*

4.2.3.1 When a length of rolled cloth or tape is measured with a steel tape, it shall not be less than 99 percent of the specified length.

4.2.3.2 When measured by winding the cloth or tape under moderate tension over a drum, having counting meter, the length shall not be less than the specified length.

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*Method for determination of dimensions of fabrics. (Since revised).

4.2.3.3 *Sewn bias-cut material* — The length of material between any two sewn joins shall be not less than 150 cm.

4.3 Electric Strength (Proof Test)

4.3.1 *Electric Strength in Free State in Air at* 90°C — The material shall withstand for one minute, without failure, the voltage specified in Table 1 when tested as prescribed in **A-2**.

TABLE 1 ELECTRIC STRENGTH IN AIR AT 90°C

THICKNESS	VOLTAGE APPLIED			
	Type 1		Type 2	
	Large electrodes*	Small electrodes*	Large electrodes*	Small electrodes*
(1)	(2)	(3)	(4)	(5)
mm	V	V	V	V
0·13	2 200	3 000	3 000	3 500
0·18	3 500	4 200	4 500	4 900
0·25	5 000	6 000	6 000	6 500

*Large electrodes shall be used for cloth and small electrodes for tapes.

4.3.1.1 The material shall be deemed to comply with this requirement, when not more than one failure has occurred in each sample on which five tests are carried out.

4.3.2 *Electric Strength of Bias-Cut Tape not Less than* 15 *mm Wide Under Mechanical Tension* — Tapes of any thickness from 0·13 to 0·25 mm shall withstand for one minute the voltage specified in Table 2, when tested as prescribed in **A-3**. Tests shall be made on specimens extended by 3 percent and 6 percent.

4.3.2.1 When it is necessary to test tape wider than 75 mm, the width shall be reduced so that specimens may be tested in the apparatus as prescribed in **A-3.2**.

4.3.2.2 Five specimens shall be tested and it is permissible that all the tests be carried out at the same time. The material shall be deemed to comply with this requirement, when out of the five tests carried out on a single test specimen at each extension, not more than one failure occurs.

TABLE 2 ELECTRIC STRENGTH AT ROOM TEMPERATURE

(*Clause* 4.3.2)

THICKNESS	VOLTAGE APPLIED			
	3 Percent Extension		6 Percent Extension	
	Type 1	Type 2	Type 1	Type 2
(1)	(2)	(3)	(4)	(5)
mm	V	V	V	V
0·13	3 000	3 500	1 500	1 750
0·18	4 200	4 900	2 100	2 450
0·25	6 000	7 000	3 000	3 500

4.3.3 *Electric Strength After Immersion in Oil* — The electric strength of the test specimen after ageing as prescribed in **B-2** shall not decrease from the original value as obtained under **4.3.1** or **4.3.2**.

4.4 Extensibility of Bias-Cut Tape — The extension of bias-cut tape shall be determined by the method prescribed in Appendix C, using a load of 7 kg per millimetre of nominal thickness per centimetre width. The percentage extension shall be as agreed to between the purchaser and the supplier. The test specimen after this test shall not have pinholes when viewed against light with the naked eye.

NOTE — The test is not applicable to tapes less than 15 mm in width.

4.5 Tensile Strength

4.5.1 The tensile strength in each direction shall be not less than the values given in Table 3 when determined as prescribed in IS: 1969-1961*.

4.5.2 The tensile strength of joins in bias-cut tape when tested by the method prescribed in IS: 1969-1961* shall be not less than the values given in Table 3.

4.5.3 The material shall be deemed to comply with this requirement if four specimens out of five meet the requirements given in Table 3 for each direction.

4.6 Tearing Strength — The tearing strength of the varnished cloth shall be determined in accordance with the procedure prescribed in Appendix D.

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*Method for determination of breaking load and elongation at break of woven fabrics (by constant-rate-of-traverse machine) *(Since revised)*.

TABLE 3 TENSILE STRENGTH

(*Clauses* 4.5.1, 4.5.2 *and* 4.5.3)

THICKNESS	STRAIGHT-CUT kg PER cm WIDTH		BIAS-CUT kg PER cm WIDTH	
	Warp	Weft	Tape	Joins
(1)	(2)	(3)	(4)	(5)
mm				
0·13	7·0	4·5	3·5	2·5
0·18	8·0	5·5	4·5	3·5
0·25	9·0	6·5	5·5	4·5

4.6.1 The tearing strength of material, both Type 1 and Type 2, shall be not less than the values given below, when the test specimens are heated at 110°±2°C for one hour and conditioned under standard atmospheric conditions (*see* IS: 196-1966*) for two hours before the test is carried out:

Thickness	*Tearing Strength*
mm	g
0.13	60
0·18	90
0·25	120

4.6.2 *Tearing Strength After Ageing in Air at* 110°*C* — When test specimens aged as prescribed in **B-1** are tested for tearing strength as prescribed in Appendix D, the percentage decrease in tearing strength from the values prescribed in **4.6.1** shall be not more than 50 percent for Type 1 and 40 percent for Type 2.

4.6.3 *Tearing Strength After Ageing in Oil for One Hour* — When test specimens aged as prescribed in **B-2** are tested for tearing strength as prescribed in Appendix D, the percentage decrease in tearing strength shall be not more than 50 percent for Type 1 and 40 percent for Type 2 of the values obtained after one hour treatment which shall be not less than the values given below for both Type 1 and Type 2:

Thickness	*Tearing Strength After Immersion in Oil for One Hour for Both Types*
mm	g
0·13	80
0·18	110
0·25	150

---

*Atmospheric conditions for testing (*revised*).

4.6.3.1 The varnished film shall also not show any evidence of disintegration in oil nor flake either in the oil or on the blotting paper used in this test.

4.7 Acidity

4.7.1 *Acidity as Received* — The acidity of the material as received from the manufacturer, when determined by the method prescribed in **E-2**, shall not exceed 12 mg potassium hydroxide per gram for Type 1 and 10 mg potassium hydroxide per gram for Type 2.

4.7.2 *Developed Acidity* — After treatment for 96 hours under the conditions prescribed in **E-3**, the acidity shall be determined as prescribed in **E-2** and it shall not exceed the value obtained initially by more than 3 mg potassium hydroxide per gram of the material. The surface of the material shall show no signs of becoming tacky after this treatment.

4.8 Humidity Resistance Test — There shall be no peeling of varnished film of the insulating cloth or tape when tested in accordance with the method prescribed in **4.8.1**.

4.8.1 A test specimen 250 mm long and 20 mm wide in case of insulation cloth and 250 mm long with original width in case of tapes shall be made into the shape of a cylinder and fastened tightly with a cotton thread. The specimen thus made shall then be suspended in a wide-mouthed bottle containing water in such a way that the test pieces do not touch the surface of water. The mouth of the bottle is then closed tight by a stopper to prevent any leakage of air. The bottle shall then be kept inside an oven for 24 hours in case of Type 1 (yellow) and 72 hours in case of Type 2 (black) at a temperature of 80°C. The test specimen shall then be removed from bottle and kept for 30 minutes at the room temperature. The test specimen shall then be visually examined to see whether there is any peeling in the insulating film.

4.9 Resistance to Microbial Attack — If required by the purchaser the material shall show no growth of micro-organism when tested as prescribed in IS: 1389-1959*.

5. PACKING

5.1 Varnished Cloth — It shall be rolled on a hollow core of suitable material approximately of 30 mm internal diameter and shall be sufficiently strong to support the cloth without collapsing. The width of the hollow core shall be not less than the full width of the varnished cloth. Moisture-proof paper shall be wrapped around the roll and folded over the ends of the roll. The ends of the roll shall be dipped in paraffin wax.

5.2 Varnished Tape — It shall be wound on a hollow core of suitable material approximately of the same length as the tape width; the core shall have an inside diameter of approximately 40 mm and be sufficiently strong to support the tape without collapsing. Each roll shall be dipped in paraffin wax The tape rolls shall be wrapped in a strong paper

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*Methods for testing cotton fabrics for resistance to attack by micro-organisms.

5.3 If required by the purchaser, the cloth and the tape shall be packed in strong wooden cases and waterproof material shall be placed around inside the wooden cases.

6. MARKING

6.1 All packages shall be marked with the following information:

a) Name and type of the material;
b) Length, width and thickness of the material;
c) Manufacturer's name or trade-mark, if any; and
d) Month and year of manufacture.

6.1.1 The packages may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7. SAMPLING

7.1 For Rolls

7.1.1 *Lot* — In any consignment, all the rolls of the same type, cut and thickness and belonging to the same batch of manufacture shall be grouped together to constitute a lot.

7.1.1.1 The conformity of the lot to the requirements of this specification shall be ascertained for each lot separately. The number of rolls to be selected for testing from each lot shall be in accordance with able 4

7.1.1.2 The rolls shall be selected at random from the lot and to ensure randomness of selection, use shall be made of a random number table. In case such a table is not available, the following procedure is recommended for use:

Starting from any roll, count them as 1, 2, 3,. . . . . . , etc, up to r and so on, where r is the integral part of N/n (N being the number of rolls in the lot and n the number of rolls to be selected for testing. Every rth roll thus counted shall be withdrawn to constitute the sample.

TABLE 4 SCALE OF SAMPLING

(*Clause* 7.1.1.1)

LOT SIZE N (1)	NUMBER OF ROLLS TO BE SELECTED n (2)
Up to 25	2
26 „ 50	3
51 „ 100	5
101 „ 300	8
301 and above	13

7.1.1.3 If, however, the rolls in a lot are packed in packages, then a suitable number of packages subject to a minimum of 2 shall be selected at random and then an equal number of rolls shall be taken from them at random according to the procedure given in **7.1.1.2** so as to make up the number required.

7.1.2 *Number of Tests*

7.1.2.1 Each roll selected in **7.1.1.2** or **7.1.1.3** shall be fully examined for requirements given in **4.1** and **4.2**.

7.1.2.2 For tests regarding all other requirements of this specification, specimens shall be cut from each roll individually.

7.1.2.3 When cutting the specimens from rolls of cloth, not less than two turns of cloth shall be removed from the roll before specimens are taken.

7.1.2.4 The sizes and number of the specimens shall be as specified under the relevant clauses and test methods of this standard.

7.1.3 *Criteria for Conformity*

7.1.3.1 The lot shall be declared to be in conformity with the requirements of this specification, if each of the selected rolls satisfies the general and dimensional requirements and passes all the tests as specified in this specification regarding electric strength, tensile strength, tearing strength and acidity.

7.2 For Reels

7.2.1 *Lot* — In any consignment, all the reels of the same length and width and manufactured under similar conditions of production may be divided into a number of groups of 5 000 reels or less. Each such group shall constitute a lot for the purpose of sampling.

7.2.2 Five sample reels shall be taken at random from each lot, and each shall be marked to identify it with the lot from which it has been taken. Each of the five sample reels shall then be tested for compliance with the specification.

7.2.3 *Criteria for Conformity* — If each of the five reels complies with this specification, then the lot from which they have been taken shall be deemed to comply, but if two or more fail to comply, then that lot shall be deemed not to comply.

7.2.3.1 If one of the five sample reels fails to comply, then a further set of five sample reels, taken at random from the same lot, shall be tested. If each of these five reels is found to comply, then that particular lot shall be deemed to comply; if one or more of these further reels fails to comply, then that lot shall be deemed not to comply with this specification.

8. TESTS

8.1 Tests shall be carried out as prescribed in the appendices to this standard.

8.2 Quality of Reagents — Unless specified otherwise, pure chemicals and distilled water (*see* IS: 1070-1960*) shall be employed in the tests.

> NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which affect the results of analysis.

APPENDIX A

(*Clause* 4.3)

PROOF TEST FOR ELECTRIC STRENGTH

A-0. PRINCIPLE

A-0.1 The test specimens are subjected to a specified voltage under experimental conditions. Note if any breakdown occurs in the test specimens. The breakdown voltage may also be noted.

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*Specification for water, distilled quality (*revised*). (**Since revised**).

A-1. GENERAL

A-1.1 The electric strength test shall be carried out with an alternating voltage of a frequency of approximately 50 c/s. The voltage shall be of approximately sine wave form and the ratio of the peak values to the rms value shall be within $\sqrt{2} \pm 5$ percent (1·34 to 1·49).

A-1.2 The peak value of the test voltage may be measured by a peak voltmeter, in which case the rms value for the purposes of this standard shall be considered as the peak value so determined divided by $\sqrt{2}$.

A-1.3 The voltage shall be applied between the electrodes and shall be raised at a uniform rate from zero to the proof voltage at such a rate that the required voltage is reached in about ten seconds.

A-2. ELECTRIC STRENGTH IN FREE STATE IN AIR AT 90°C

A-2.1 Test shall be carried out at five places on each specimen.

A-2.2 Apparatus

A-2.2.1 *Electrodes* — The bottom electrode shall consist of a solid cylinder of brass 75 mm in diameter and 25 mm in height. The upper electrode shall consist of a solid cylinder of brass 25 mm in diameter and 25 mm in height. The sharp edges of the electrodes shall be rounded to a radius of 3 mm. The test faces shall be kept smooth and polished and free from pitting. The electrodes shall be held truly coaxial while testing.

A-2.2.2 *Testing Transformer* — The capacity of the transformer shall be sufficient to maintain the full test voltage on the specimen for the maximum time required for the test. A rating of 2 to 5 kVA depending upon the output voltage shall normally be considered sufficient. The transformer circuit should be protected from excessive current by a circuit breaker.

A-2.2.3 *Voltage Control* — Control of voltage may be secured by using one of the following devices:

a) Variable ratio auto-transformer,
b) Induction regulator,
c) Generator field regulator (for separate alternator), or
d) Resistance potential divider.

A-2.3 Procedure — Heat the specimen and the electrodes in an oven maintained at 90°±2°C for one to two hours and maintain the same temperature throughout the test. Then apply the voltage as specified in Table 1 for one minute and note if any breakdown has occurred in the specimen.

A-3. ELECTRIC STRENGTH ON BIAS-CUT TAPE NOT LESS THAN 15 mm UNDER MECHANICAL TENSION

A-3.1 The specimens shall be conditioned at 27° ± 2°C and 65 ± 5 percent relative humidity for 24 hours prior to testing and the testing shall be done as quickly as possible after removal, if necessary, from the standard conditions

A-3.2 Apparatus — An electrode assembly of the type described below and illustrated in Fig 1, shall be used for unextended tape

A-3.2.1 *Electrodes* — The electrodes shall consist of two brass rods, each 6 mm in diameter, with the edge rounded to a radius of approximately one millimetre The weight of the upper rod shall be 50 ± 2 g The rods shall be placed with their common axis perpendicular to the surface of the specimen

NOTE — The electrodes need frequent attention as they become pitted and it may not be sufficient to clean them with emery cloth or by similar means Where necessary, they shall be turned in a lathe in order to maintain the ends truly flat and perpendicular to the axis

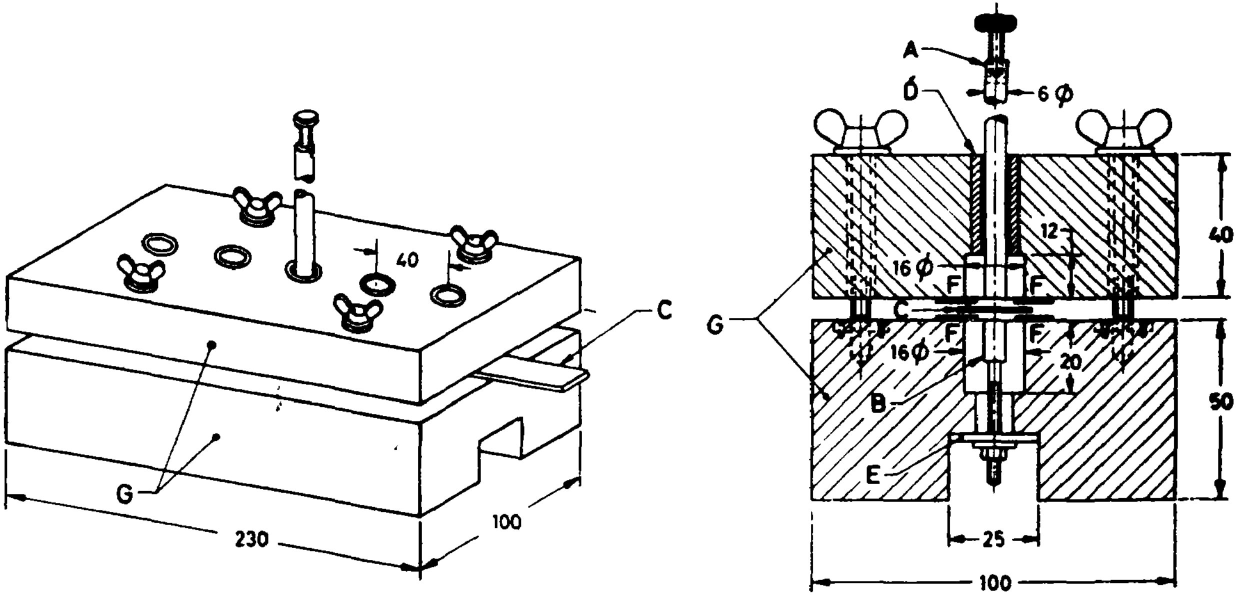
A-3.2.1.1 The electrode apparatus consists of two blocks of paper-filled laminates, impregnated wood or other suitable insulating material, one (the lower block) 230 × 100 × 50 mm and the other 230 × 100 × 40 mm

A-3.2.1.2 In the upper block, five holes are drilled, the upper half of hole being fitted with a brass bush having a 6-mm clearance hole, the lower half of each hole being 15 mm in diameter When the upper electrodes are inserted into these holes, they rest on the sample under test immediately above the lower electrodes fitted into the lower block Each upper electrode is fitted with a terminal by means of which connection is made to the high voltage side of the supply

A-3.2.1.3 The lower block has a slot 25 × 22 mm running centrally along the length and into this slot a brass strip, which runs the whole length of electrode apparatus, is fixed To this strip, the five lower electrodes are fastened rigidly, and the strip is connected to a terminal at one end, by means of which connection is made to the ' earthed ' side of the supply Each of the lower electrodes protrudes upwards through the wood, standing centrally in a 15-mm diameter hole drilled in the block, the top of the electrodes being absolutely flush with the top surface of the lower block. These electrodes are 40 mm apart

A-3.2.1.4 The upper block may be clamped firmly to the lower block by means of suitable clamping rods, which also locate the top and bottom blocks in their correct relative positions, so that the corresponding upper and lower electrodes will be axially in line

A-3.2.1.5 The sample under test lies between the electrodes, and is firmly clamped in position by the two blocks In order to prevent flashover round the sample, strips of varnished cloth are placed along



1A General Arrangement of Apparatus

1B Section of Apparatus Through Electrodes with Top Slightly Raised

A = Upper electrode which can easily fit in bush D;
B = Lower electrode,
C = Sample under test,
D = Brass bush with inside diameter just sufficient to clear 6-mm rod;
E = Brass strip 25-mm wide connecting all lower electrodes,
F = Pieces of varnished cloth strip overlapping edges of sample, and
G = Blocks of suitable insulating material, for example, a paper filled laminate.

All dimensions in millimetres

Fig. 1 Typical Example of Electrode Apparatus for Electric-Strength Test for Tape

the length of the testing apparatus on both upper and lower blocks. The edges of the sample under test are clamped firmly between these strips when the top is in position, but no overlapping is allowed between these and any of the electrodes.

A-3.2.2 *Stretching Machine* — A suitable apparatus for stretching the tape consists essentially of a rigid frame carrying two similar clamps on opposite sides. Adjacent to one clamp is a rod which can be rotated by means of a handle and to which the specimen may be attached for the purpose of stretching. The frame may, if desired, accommodate more than one specimen, a number of clamps being arranged in two opposite rows, as shown in Fig. 2. The frame shall be mounted so that the stretched specimen will be 50 mm above the testing table or baseboard in order to coincide with the tops of the lower electrodes of the electrode apparatus as described in Fig. 1.

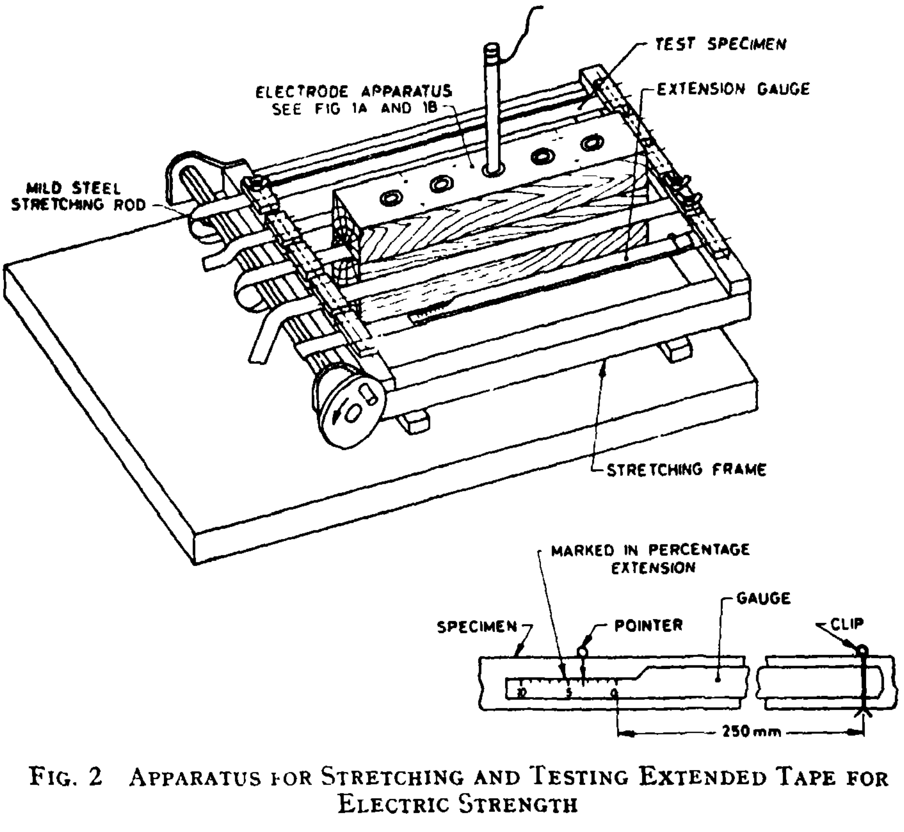

TEST SPECIMEN
EXTENSION GAUGE
ELECTRODE APPARATUS SEE FIG 1A AND 1B
MILD STEEL STRETCHING ROD
STRETCHING FRAME
MARKED IN PERCENTAGE EXTENSION
GAUGE
SPECIMEN
POINTER
CLIP
10
5
0
250 mm

FIG. 2 APPARATUS FOR STRETCHING AND TESTING EXTENDED TAPE FOR ELECTRIC STRENGTH

A-3.2.3 An alternative apparatus where the stretching device is combined with the lower electrodes block is shown in Fig. 3.

A-3.3 Procedure

A-3.3.1 Clamp a sample of the tape approximately 450 mm long at one end in one of the clamps on the stretching machine, remote from the stretching rod; pass the other end through the opposite clamp which is not tightened, and then attach to the stretching rod. The length of the specimen between the clamps shall be not less than 300 mm. Rotate the stretching rod by means of the handle, so that the tape is wrapped round the rod in one or more turns and supply tension and increase rapidly until the specimen has been stretched to the specified extension. (Approximately five seconds should be taken for this operation.)

A-3.3.2 A suitable means of readily observing the true extension of the specimen is to affix a light gauge of paper or aluminium approximately 290 mm long, to the specimen by means of a wire clip at one end, about 25 mm from one clamp, the other end of the gauge being marked in

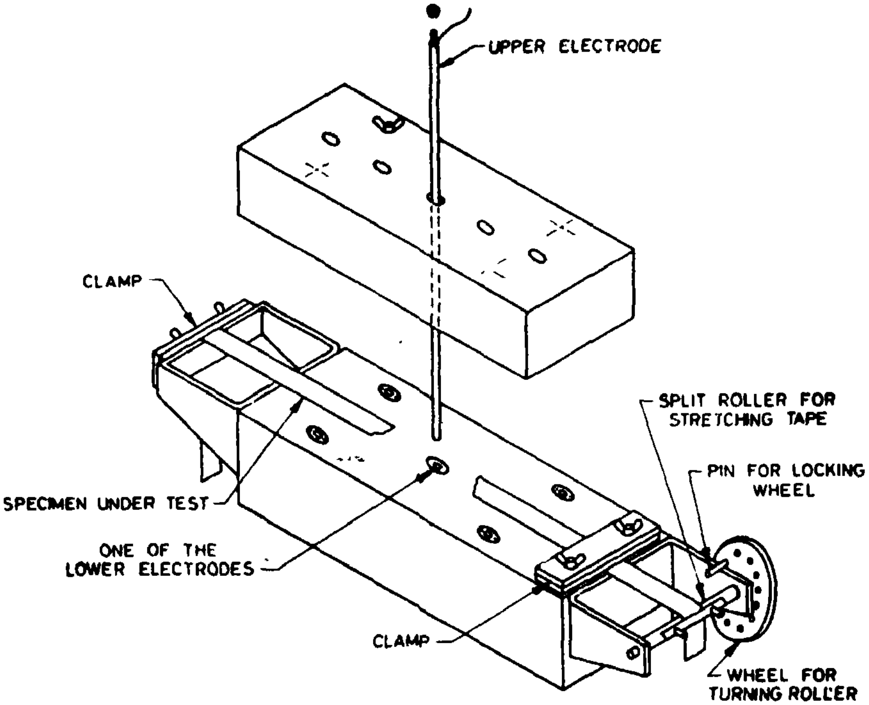


FIG. 3 DEVICE COMBINED WITH ELECTRODES FOR TESTING EXTENDED TAPE FOR ELECTRIC STRENGTH

percentage extension on a length of 250 mm from the clip. A light pointer is attached to the specimen at 250-mm gauge mark before it is extended. The tape is extended until the pointer is opposite the appropriate extension mark on the gauge.

A-3.3.3 When the specified extension is reached, tight the clamp adjacent to the stretching rod so that the portion of the specimen between the two clamps is rigidly held extended to the specified degree. Allow the tape to remain in the stretched condition for not less than 10 minutes and not more than 30 minutes, and insert while still in the stretched condition in the electrode apparatus. Apply the specified proof-test voltage as specified in Table 2 between the electrodes and maintain for one minute.

APPENDIX B

(*Clauses* 4.3.3, 4.6.2 *and* 4.6.3)

DETERMINATION OF TEARING STRENGTH AFTER AGEING

B-0. PRINCIPLE

B-0.1 The test specimen after ageing in air and in oil under specified conditions is subjected to tearing action in the test machine and the load required to tear the specimen is noted.

B-1. AGEING IN AIR AT 110°C

B-1.1 Procedure — Suspend ten specimens of varnished cloth (all either in the warp or weft direction) suitably cut for use in the Marx-Elmendorf type tearing tester in a uniformly heated air oven maintained at a temperature of 110°±2°C. At the end of one hour, remove five specimens and condition them at a temperature of 27°±2°C and 65±5 percent relative humidity (*see* IS: 196-1966*) for two hours. Determine the tearing strength immediately as prescribed in Appendix D. The mean value obtained for the five specimens shall be the tearing strength of the varnished cloth after ageing for one hour.

---

*Atmospheric conditions for testing (*revised*).

B-1.2 At the end of 48 hours, remove the remaining five specimens and test as prescribed in Appendix D.

B-1.3 Calculate the percentage decrease in tearing strength of the specimens aged for 48 hours from the mean value of the five specimens aged for one hour.

B-2. AGEING IN OIL AT 110°C

B-2.1 Suspend ten specimens of varnished cloth (all either in the warp or weft direction) suitably cut for use in the Marx-Elmendorf type tearing tester, without touching each other, in an insulating oil (conforming to IS: 335-1953*) maintained at a temperature of 110°±2°C At the end of one hour, take five specimens out of the oil and remove the surplus oil by means of blotting paper. Condition the specimens at a temperature of 27°±2°C and 65±5 percent relative humidity (*see* IS: 196-1966†) for two hours. Determine the tearing strength immediately as prescribed in Appendix D. Calculate the mean value of tearing strength obtained on the five specimens aged in oil for one hour.

B-2.2 At the end of 48 hours, remove the remaining five specimens and test as prescribed in Appendix D.

B-2.3 Calculate the percentage decrease in tearing strength of the specimens aged for 48 hours from the mean value of the five specimens aged for one hour.

APPENDIX C

(*Clause* 4.4)

DETERMINATION OF EXTENSIBILITY OF BIAS-CUT TAPE

C-0. PRINCIPLE

C-0.1 A specified load is applied at the free end of the test specimen and extension of the distance between two marked positions on the tape is noted.

---

*Specification for insulating oil for transformers and switchgear (low viscosity type) (Second revision in 1972).

†Atmospheric conditions for testing (*revised*).

C-1. TEST SPECIMENS

C-1.1 Test shall be carried out on five test specimens.

C-1.2 Cut test specimens not less than 450 mm long from each reel.

C-2. CONDITIONING

C-2.1 Keep the test specimens at a temperature of 27°±2°C and 65 ±5 percent relative humidity for 24 hours (*see* IS : 196-1966*). Carry out the test in the same atmosphere.

C-3. PROCEDURE

C-3.1 Mark two parallel marks on each test specimen at a distance of 250 mm, leaving a free length of 100 mm on both sides. Suspend each specimen in a vertical position by means of a clamp, so that it is at least 25 mm, away from the marked position. Apply the load for 10 ± 1 minutes as specified in **4.4** at a distance of not less than 25 mm away from the marked position by means of a suitable clamp, the weight of which is also included in the specified load. Measure the distance between the marks, while the load is still applied.

C-4. CALCULATION AND REPORT

C-4.1 Calculate the extension in length as a percentage of the initial distance between the reference lines. The mean of the five results shall be reported as the percentage extension of the tape.

APPENDIX D

(*Clauses* 4.6, B-1 *and* B-2)

DETERMINATION OF TEARING STRENGTH

D-0. PRINCIPLE

D-0.1 The test specimen is subjected to tearing action and the load required to tear the specimen is recorded.

---

*Atmospheric conditions for testing (*revised*).

D-1. TEST SPECIMENS

D-1.1 The tearing strength of the cloth shall be determined on five test specimens in which the warp threads are torn and five test specimens in which the weft threads are torn and the mean value of tearing strength in each direction shall be determined.

D-1.2 Specimens, approximately 100 × 62 mm shall be cut from the cloth, the longer dimensions being parallel to the threads to be torn. By means of a suitable slitting device, two slits shall be cut in each specimen on one of the 100-mm side at a distance of approximately 25 mm for insertion in the movable clamp, together with two outer tongues of approximately 25 mm width each for insertion in the fixed clamp. The length of the slits is not critical, provided the distance from the end of each to the uncut 100-mm edge of the specimen is 44 mm. This distance of 44 mm represents the length to be torn.

D-2. APPARATUS

D-2.1 The test shall be carried out on a Marx-Elmendorf type tear testing machine (*see* Fig. 4). It shall be provided with a sharp blade capable of producing uniform slit in the specimen.

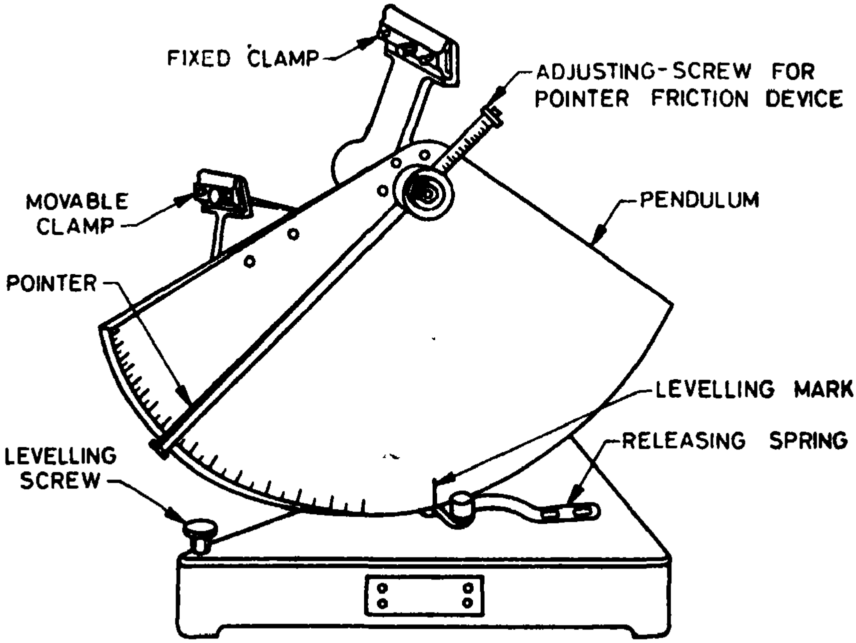


FIG. 4 GENERAL VIEW OF MARX-ELMENDORF TYPE TEARING STRENGTH TESTER

D-3. CONDITIONING

D-3.1 The specimens shall be conditioned at a temperature of 27° ±2°C and 65±5 percent relative humidity for 24 hours.

D-4. PROCEDURE

D-4.1 Before making tests, the zero setting and level of the machine shall be checked and, if necessary, adjusted in accordance with the machine manufacturer's instructions. The test shall be carried out so that the tearing load falls between 20 and 80 percent of the maximum on the scale. To ensure this, a check test specimen on each direction of the sample shall be torn. If the tearing load of the single test piece falls outside the specified range of the scale, two or more test pieces, superimposed but not bonded, shall be tested at the same time. In that case, sufficient test pieces shall be cut from the sample to enable five groups of test pieces to be tested for each direction.

D-4.2 Set the pendulum and pointer in their initial position Clamp the two external tongues of the rectangular specimens in the fixed clamp and the central tongue in the movable clamp fixed to the pendulum The clamping shall be done in such a way that the sample is not strained, but a slight bend in the unclamped portion of the tongue is of no consequence (*see* Fig. 5, 6 and 7). Subject the test piece to the tear test by releasing the pendulum so that it acts on the test piece and record the scale reading.

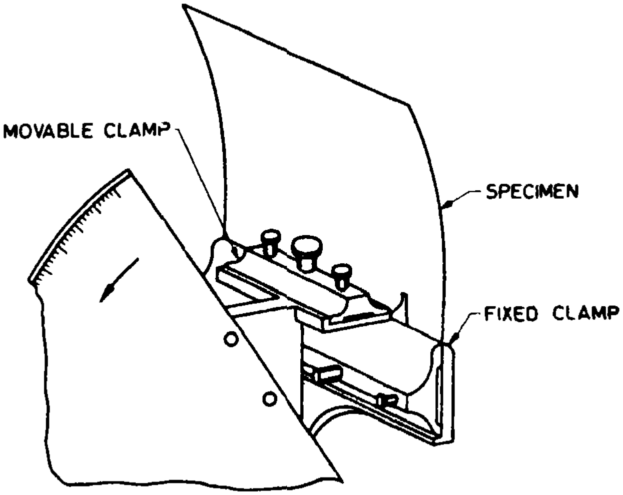


FIG. 5 METHOD OF CLAMPING SPECIMENS FOR TEST IN THE MARX-ELMENDORF TYPE TEARING STRENGTH TESTER

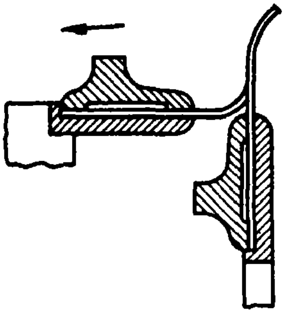
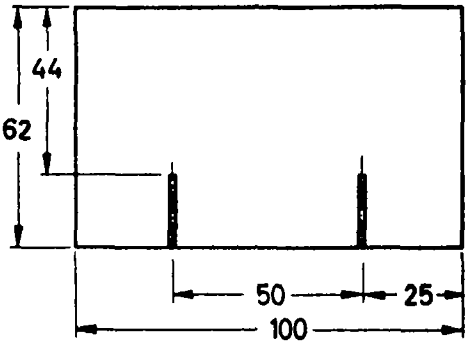


FIG. 6 SECTIONAL ELEVATION OF CLAMPS AND SPECIMEN



All dimensions in millimetres.

FIG. 7 TEST SPECIMEN SHOWING TONGUE

D-4.3 Release the pendulum and allow it to complete freely its swing to the right, but the brake may be applied any time after the commencement of the return swing to the left and the pendulum brought to rest. The position of the pointer on the .pendulum is then read off. The pendulum step shall be released sharply in operating the instrument. Scale readings shall be read to the nearest integer.

D-5. CALCULATION

D-5.1 The tearing strength of the test specimen in grams is calculated by multiplying the actual reading of the scale by the constant of the instrument (usually three).

D-6. REPORT

D-6.1 The mean of five results shall be reported as tear strength for the warp and weft directions.

APPENDIX E

(*Clause* 4.7)

DETERMINATION OF ACIDITY AND DEVELOPED ACIDITY

E-0. PRINCIPLE

E-0.1 The acidic components of the test specimens, fresh and after being exposed to humid conditions as specified, are extracted with an alcohol-benzene mixture at its boiling point and estimated by titration with standard alkali.

E-1. REAGENTS

E-1.1 Benzene — conforming to IS: 1840-1961*.

E-1.2 Ethyl Alcohol — conforming to IS: 321-1952†.

E-1.3 Standard Alcoholic Potassium Hydroxide Solution — 0·1 N.

E-1.4 Phenolphthalein Indicator Solution — Dissolve 0·1 g of phenolphthalein in 100 ml of 60 percent rectified spirit.

E-2. DETERMINATION OF ACIDITY

E-2.1 Weigh specimen of varnished cloth, 150×100 mm, or of an equivalent area of tape and cut into small pieces (approximately 25×3 mm). Boil these pieces gently under reflux for 30 minutes in 100 ml of a 1:1 mixture of benzene and ethyl alcohol, after which the liquid may be decanted and filtered, if necessary. The mixture used shall be neutral and a blank test shall be made, if necessary. Wash the flask and contents with a further 25 ml of hot solvent mixture and add this to the first extract. Titrate this extract with 0·1 N alcoholic potassium hydroxide, using phenolphthalein as indicator until the pink colour persists for 30 seconds

E-2.2 The mean of the three results shall be taken as the acidity.

E-3. DETERMINATION OF DEVELOPED ACIDITY

E-3.1 Weigh each of the three specimens of the varnished cloth, 150×100 mm, or an equivalent area of tape. Wind each specimen closely on a 6-mm diameter borosilicate glass rod and insert each rod and specimen horizontally in a borosilicate glass test-tube of approximately 25 mm diameter and 150 mm long (*see* IS: 2618-1963‡). Place the test-tube horizontally on the shelf of a chamber maintained at 80 to 85 percent relative humidity and a temperature of 45°±2°C for 96 hours. After this treatment, determine the acidity as prescribed in **E-2.1**.

Note — An atmosphere of 80 to 85 percent of relative humidity at a temperature of 45°±2°C may be obtained by the use of saturated solution of potassium chloride at that temperature.

E-3.2 The mean of the three results obtained shall be taken as the developed acidity

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*Specification for benzene, reagent grade.

†Specification for ethyl alcohol (absolute alcohol) *(Since revised)*

‡Specification for test-tubes.

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